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INLET MANIFOLD FOR INTERNAL COMBUSTION ENGINES

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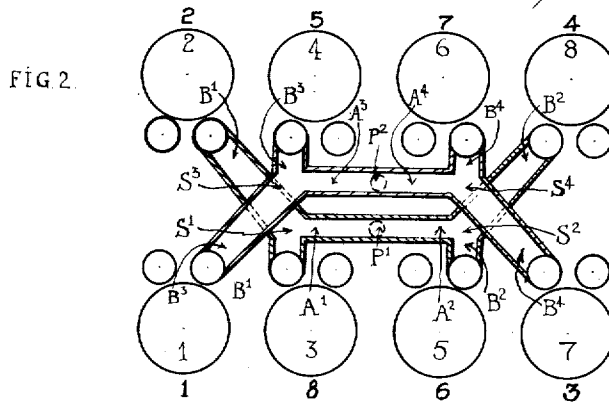
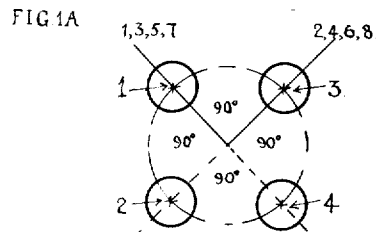
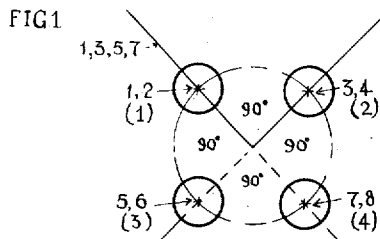
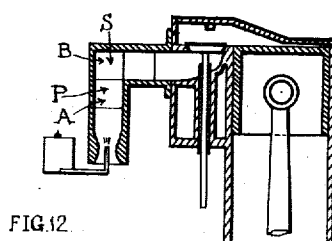
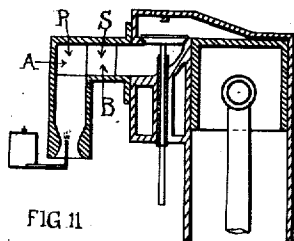
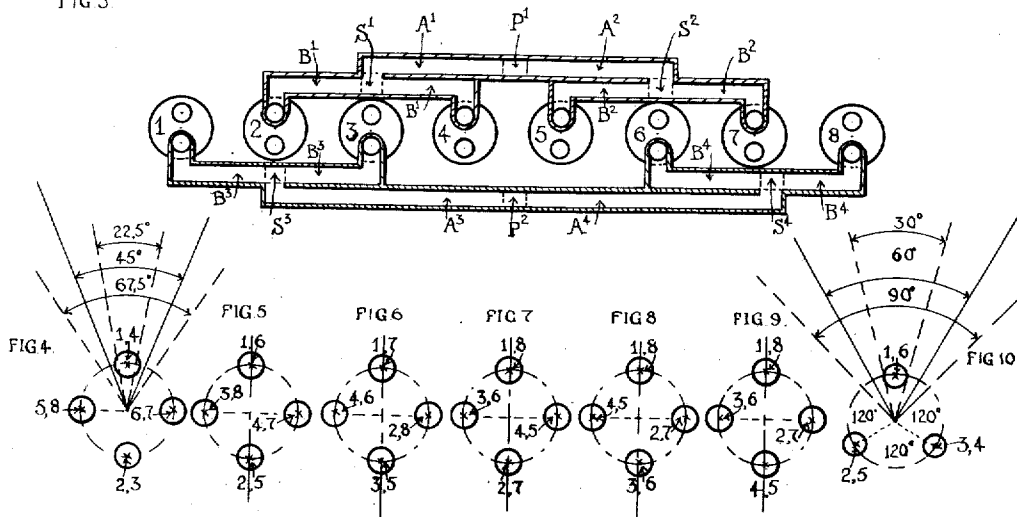


FIG 3



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INLET MANIFOLD FOR INTERNAL COMBUSTION ENGINES

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My invention relates more particularly to the distribution of a fuel-air mixture to the cylinders of straight type and a V type motor, having two rows of cylinders at an angle, or a multiple of two rows. The sequence of the suction periods depends upon the arrangement of the crankpins and the angle of the cylinder banks.

The present method includes an irregular distribution of gases, which nevertheless permits a satisfactory functioning of said engines at low and high speeds. In some combinations shown the distribution is unequal in both manifolds, in other types only in one.

The present invention is partial substitute of my application Ser. No. 101,715, of April 13, 1926, and in the present application the subject matter of some of the old figures thereof is carved out, though the scope of the subject matter of said entire application is also applicable on the present subject matter.

The first object of my invention is to distribute the gas, especially a fuel-air mixture as equally as possible in a straight eight cylinder and in a V eight cylinder having perfect balance.

My second object is to obtain said gas distribution by the use of a double manifold, (or so-called dual manifold if provided with a carburetor which delivers the fuel through different jets to both manifolds; both manifolds may have a common air inlet or common air cleaner as is common practice nowadays and as shown in my applic. 249,756, Jan. 26, 1928, this optional feature has here nothing to do with the characteristics of the double-manifolding-distribution as such), connecting each with four cylinders having equal suction intervals of 180 degrees.

My third object is to combine said manifolds (or method of gas distribution by means of double manifolds) with crankpin arrangements which insure complete balance of the reciprocating parts, that means the balance of the primary and secondary inertia forces without the existence of a single couple of either of said two inertia forces.

Other objects will appear hereafter, which refer to the application of the present methods on engines having 6 or 8 or more cylinders in each bank, and a total of 12 and 16 or more cylinders in both banks. Figs. 1, 1A, 4 to 10 refer to crankpin arrangements, Figs. 2, 3, 11, 12, to manifold arrangements. In the following lines referring to Figs. 1 and 1A the numbers within parentheses are referred to.

Figs. 1 and 1A refer to the crankpin arrange-

ments of the V eight cylinder, Fig. 2 refers to the manifold-arrangement thereof. Figs. 3 and 8 form a combination similar thereto. The Figs. 4-7 and 9 refer to crankpin arrangements of 8-cylinder engines, which may use similar manifold arrangements. Fig. 10 refers to the crankpin arrangement for 12-cylinder engines, having 6 cylinders in each row. Each group of 6 cylinders, having suction periods with equal intervals, may be provided with a single carburetor.

Fig. 11 shows the transverse section of Fig. 3 on the section line S11—S11.

Fig. 12 shows the transverse section of the manifold of Fig. 3, when the branches A¹ and A² lie below the secondary branches B¹ and B² of Fig. 3. Fig. 12 shows the transverse section of Fig. 3C on the section line S12—S12, and reversely Fig. 3C shows Fig. 12 on the section line S12—S12.

Fig. 3A shows the longitudinal section of the larger manifold of Fig. 3 on the section line 3A—3A, and the longitudinal section of Fig. 11 on the section line S3A—S3A.

Fig. 3B shows the front view of the larger manifold of Figs. 3 and 11.

Fig. 3C shows Fig. 12 on the section line S3C—S3C.

Figs. 2A and 2B show diagrammatically the position of the inlet manifolds for the V type, the two inlets of which are connected with an air-cleaner.

Fig. 2A is a view of Fig. 2B on the section line S2A—S2A, and reversely Fig. 2B is a top view of Fig. 2A, on the section line 2B—2B.

In Fig. 1 crankpins 1 and 4 are opposite each other in one plane, and crankpins 2 and 3 are opposite each other in another plane perpendicular to said first plane, so that crankpins 1 and 2 are at 90 degrees to each other and equally crankpins 3 and 4. In Fig. 1A crankpins 1 and 4 are equally in one plane, and also crankpins 2 and 3. However crankpins 2 and 3 have changed places in Fig. 1A compared with Fig. 1, so that they read in clockwise direction in the order 1, 3, 4, 2. In Fig. 1 said order was 1, 2, 4, 3. The perfect balance of the reciprocating parts remains the same in both varieties.

In Fig. 2 cylinders 1, 4, 6, 7 are connected with one manifold having a primary zone P², primary branches A³ and A⁴, and secondary zones S³ and S⁴, and secondary branches B³ and B⁴. The cylinders 2, 3, 5, 8 are connected with another manifold, having a primary zone P¹, primary branches A¹ and A², secondary zones S¹ and S², and secondary branches B¹ and B².

In Fig. 3 is shown a straight eight cylinder. The cylinders are equally arranged here in two groups according to the crankpin arrangement of Fig. 8. Cylinders 2, 4, 5, 7 have a manifold with a primary zone P¹, having two branches A¹ and A². Branch A¹ leads to a secondary zone S¹, having secondary branches B¹ leading respectively to the inlet valves of cylinders 2 and 4. Branch A² leads equally to a secondary zone S², having two branches B², one of which leads to cylinder 5, and one to cylinder 7. Cylinders 1, 3, 6, 8 have an equivalent arrangement, a primary zone P², two secondary branches A³ and A⁴, leading respectively to secondary zones S³ and S⁴. The secondary branches B³ from zone S³ lead respectively to the inlet valves of cylinders 1 and 3, while the secondary branches B⁴ from the secondary zone S⁴ lead respectively to the inlet valves of cylinders 6 and 8.

A particular feature of the manifolding of the straight eight shown in Fig. 3 is, that they are placed at opposite sides of the engine in order to provide more place for the valves, exhaust manifolds (not shown), and providing space to make the length of the manifolding substantially equal to each other. If they are arranged both at the same side they impede each other. These details will be discussed later and are features specific only to the straight type, unless applied on the 16 cylinder V type.

Figures 4 to 9 show the various crankpin arrangements which can be used for the straight eight in order to balance completely the primary inertia forces. In the unsymmetrical arrangements of Figs. 4, 5 and 6 a couple of the secondary inertia forces causes an unbalance in these types of engines, while in the symmetrical arrangements of Figs. 7, 8 and 9 all inertia forces are completely and entirely balanced like in the arrangement of Fig. 1 for the eight cylinder of the V type.

Fig. 10 shows the standard arrangement of the straight six cylinder engine, which crankshaft can be used for the 12 cylinder V type.

The crankpins shown in Figs. 4-9 can be equally used for the 16 cylinder V type using the double manifolding of Fig. 3 for each group of eight aligned cylinders.

Fig. 11 shows the manifolding of Figs. 2 and 3 in cross section in a plane perpendicular to the axis of the crankshaft and passing through the primary zones of said manifolding. The primary zone P and primary passages A are shown in the same horizontal plane together with the secondary zones and secondary branches B, but in Fig. 12 the riser with the fuel mixing means leads to the primary zone P, and branches A, and the secondary zones and branches are located above the primary zone and branches and not in the same plane. Fig. 11 is a sectional view of Fig. 3. Though a valve-in-head engine is shown in Fig. 3 and in Fig. 11 an L-head construction, it is evident that the manifold of Fig. 11 can be constructed for a valve-in-head engine, similar to the one shown for an L-head motor. The dotted lines in Fig. 11, merely indicate how the rectangular zones of distribution are located with respect to each other, (in a plane transverse to the Fig. 3) and the dotted lines in Fig. 12 show equally how these zones are situated with respect to each other, when the primary zone P and the primary branches A³ and A⁴ (or A¹ and A²) are constructed below the secondary branches B³ and B⁴ (or B¹ and B² on the other side of the engine).

In the combination of Figs. 1 and 2 different conditions of gas distribution obtain in the two groups. For the group of cylinders 1, 4, 6, 7 connected with manifolding, the sequence obtainable with the crankpin arrangement of Fig. 1 is either 1, 7, 4, 6 or 1, 6, 4, 7. That means the successive suction periods are alternating from the primary zone P². However, in the other group of cylinders 2, 3, 5, 8 the suction sequence is either 3, 5, 8, 2 or 3, 2, 8, 5 and the immediate successive suction in this group are not alternating in this group, one suction going in one direction from the primary zone P¹ and the next suction going in the same direction therefrom, creating a purely unbalanced gas distribution in this group of four cylinders, and in contradistinction to the other group 1, 4, 6, 7 having a purely balanced gas distribution.

When exchanging in Fig. 5 the position of the crankpins 2 and 3, the suction sequence becomes in the cylinder group 1, 4, 6, 7, either 1, 4, 6, 7 or 1, 7, 6, 4, the successive suction periods not alternating from the primary zone P². The suction sequence, however, in the other group of four cylinders 2, 3, 5, 8 becomes either 2, 5, 3, 8 or 2, 8, 3, 5, purely alternating in direction of flow of the air-fuel mixture from the corresponding primary zone of distribution P¹.

Reversing the position of the crankpins 1 and 4 creates conditions similar to the ones explained, the gas distribution in one group of cylinders remaining different from that of the other group. This crankpin arrangement of Figs. 1 and 1A which only gives perfect balance to the reciprocating parts allows therefore two different positions of the crankpins, each position allowing 8 different suction sequences in clockwise direction and 8 in counterclockwise direction, a total of 32 different suction sequences. In all of them the condition of gas distribution in the two manifolds remains unequal, that means it is balanced in one manifold and unbalanced in the other manifold.

In Fig. 3 combined with the crank in arrangement of Fig. 8 the same conditions of unbalanced gas distribution obtain as explained for the combination of the Figs. 1 and 2. The suction sequence for the group of cylinders 1, 3, 6, 8 is either 1, 3, 8, 6 or 1, 6, 8, 3. For the other group of four cylinders 2, 4, 5, 7 these sequences are 4, 7, 5, 2 or 4, 2, 5, 7. Unbalanced gas distribution in both groups equally.

When using the other crankpin arrangements of Figs. 4, 5, 6, 7 and 9, the manifolding has to be rearranged to conform with the crankpin arrangement.

In case it is preferred in the V type 12 and 16 cylinder type to connect half of the cylinders with one carburetor and the other half with another carburetor, the following arrangement of Fig. 2 should be applied.

In the eight cylinder of Figs. 1 and 2 the four crankpins are arranged in four radial planes so that two pistons, one in each group, reach their top position simultaneously. Likewise in the 12 cylinder V type the crankpins are then not arranged in three planes as shown in Fig. 10, (that is equivalent to Fig. 15 in said parent case 101,715 of April 13, 1926) but in six radial planes, as shown in my Patent 1,911,874, quoted somewhere else in this description. Looking at Fig. 10, it is evident that this can be done in various ways. If crankpins 1, 2, 3 are placed at 120° and crankpins 4, 5, 6 at 120°, and these two sets of

three crankpins at 60°, (according to the standard 60° angle of the twelve cylinder V type) it is evident that cylinders 1, 3, 5 and 8, 10, 12 are in one group having suction intervals of 120°, and cylinders 7, 9, 11 and 2, 4, 6 being in the other group, having equally 120° intervals between immediate successive suctions in that group of 6 cylinders.

The pistons 1 and 12, 3 and 10, and 5 and 8 reach their top positions simultaneously in said first group with intervals of 120°. Likewise the pistons in cylinders 7 and 6, and 9 and 4, and 11 and 2 reach their top position simultaneously and with equal intervals in said second group of six cylinders. It must be remembered hereby, that the crankpins are numbered consecutively in one direction, as shown in Fig. 1A and in parentheses in Fig. 1. The cylinders are, however, so numbered that the uneven numbers are in one bank, the even numbers in the other bank.

If the crankpins 1, 3, 5 are placed at 120°, and 6, 4, 2 at 120° and these two sets of three crankpins again at the cylinder angle (as explained in Fig. 10), the cylinders 1, 5, 9, 2, 6, 10 are in one group of six cylinders with equal suction intervals and the cylinders 3, 7, 11, 4, 8, 12 in the other group. Likewise here, two pistons, one in each bank, reaches its top position substantially at the same time.

Likewise in the 16 cylinder V type, if it is preferred to feed half of the cylinders, having equal suction intervals of 90°, with one carburetor and the other half with another carburetor, one half of the crankpins is placed at 90° and the other half at 90°, these two sets of four crankpins again at the cylinder angle shown in Fig. 4, (conform with Fig. 1 and 1A of the V eight cylinder).

For instance in Fig. 4, if crankpins 1, 2, 5, 6 are at 90° and crankpins 3, 4, 7, 8 at 90°, the cylinders 1, 3, 9, 11, 2, 4, 10, 12 are in one group and the cylinders 5, 7, 13, 15, 6, 8, 14, 16 in the other group.

If crankpins 1, 2, 7, 8 remain at 90° and 4, 5, 6, 3 at 90°, both sets being arranged at the cylinder angle, cylinders 1, 3, 13, 15, 2, 4, 14, 16 are in one group and cylinders 5, 7, 9, 11, 6, 8, 10, 12 are in the other group. The manifolding being correspondingly crosswise as shown in Fig. 2 for the eight cylinder V type (in contradistinction to Fig. 13 (old)).

Likewise for the group of crankpins shown in Figs. 5 to 9, the crankpins 1, 2, 3, 4 may remain at 90° and the crankpins 5, 6, 7, 8 may remain at 90°, but the 8 crankpins become arranged in eight radial planes by arranging said two sets of four crankpins at the cylinder bank angle. Again here two pistons, one in each bank reach their top position simultaneously, as explained for the 12 cylinder and 8 cylinder V type.

However it is understood that in Fig. 5 for instance crankpins 1, 8, 7, 2 may remain at 90°, and crankpins 6, 3, 4, 5 at 90° in the other group. The corresponding cylinders will be grouped again in two groups, each group having suction intervals of 90°.

In Fig. 6 crankpins 7, 6, 8, 5 may remain at 90° and also crankpins 1, 4, 2, 3 at 90°, and similar modifications in the other figures.

Recapitulating the arrangements of the straight eight type, the twelve cylinder V type and 16 cylinder V type, it appears that for the straight eight the grouping in two halves is as follows.

For the type of Fig. 4, each group of four cyl-

inders would be composed of adjacent cylinders, while for all the other groups of Figs. 5 to 9, each group of four cylinders would be composed of non-adjacent cylinders.

When considering the secondary branches, in the arrangements of Figs. 4, 5, 7, the secondary branches would lead to adjacent cylinders, while in Figs. 6, 8, 9 they would lead to non-adjacent cylinders. In Fig. 9 for one group to adjacent cylinders, for the other to non-adjacent cylinders.

In the sixteen cylinder V type, each block of eight cylinders can be fed as shown in Fig. 3, or they can be fed in two groups of eight cylinders as shown in Fig. 2, and as explained above. In the latter case each group of eight cylinders are never adjacent.

In the twelve cylinder, each bank of six cylinders can be fed by one carburetor if this twelve cylinder has the crankpin arrangement in three radial planes as shown in Fig. 10. Or each group may be composed of six cylinders, three cylinders in each bank of cylinders, and the crankpins are arranged correspondingly in six radial planes conforming with Figs. 1, 1A and 2 of the eight cylinder.

Therefore, in case, in the following claims, I speak of branches to non-adjacent cylinders, the Figures 6, 8, and 9 only are included for the straight eight. For the twelve cylinder V type, again only the type having crankpins arranged in 6 radial planes would be included. In the case of the 16 cylinder type, either the type of Fig. 3 applied on Figs. 6, 8, 9 would be included, (four carburetors being used) or the type in which the eight crankpins are arranged in eight radial planes as explained, in which latter case two carburetors of the type of Fig. 2, are used instead of four, one for each group of eight cylinders, four in each bank.

In case, in the following claims, I speak of non-adjacent cylinders every type of double carburetion discussed would be included (only including Figs. 6, 8, 9 for the straight 8 cylinder type.)

However, the former arrangements in which cylinders of each group of half the total number of cylinders are spread over both banks of cylinders, are preferred. In case the carburetion system of one group of half the cylinders functions differently from the other group, it would be less notable than when each bank of cylinders has only one inlet manifold and (or) one carburetion system.

Equally, if the ignition system is so arranged that each bank of 4, 6, 8 or more cylinders has a separate ignition-system (Injection system for Diesel engines, each group as explained having a single inlet manifold) and one system functions for any reason whatsoever differently from the other, it stands to reason after the present explanation, that if the gas distribution is spread crosswise over the two banks of cylinders, that this difference in these ignition or injection systems is felt less, as the amount of gas and air in said group will be equally for an equal number of cylinders in both groups. If the gas distribution and ignition falls in one bank, the entire bank is out.

This difference in the operation of ignition or distribution holds even in the straight eight type. Carburetion or injection systems in two groups, when connected to the cylinder grouping of Fig. 4, will affect the running balance of the engine more, when they begin to differ, than in the types of Figs. 5 to 9. And of the five latter types,

those of 6, 8 and 9 are also superior in this respect than those of 5 and 7. This consideration is apart from the running balance caused by the crankpin arrangement per se, either in the straight type or V type.

The crankpin arrangements of Figs. 7, 8, 9 are preferred as they cause perfect balance of the reciprocating parts while those of Figs. 4, 5, 6 do not.

The standard angle for the V eight cylinder is 720 degrees divided by the number of cylinders. Decreasing or increasing the cylinder angle 50% to respectively 45 and 135 degrees would not affect the sequence of the suctions in each cylinder group. The same increase or decrease may be applied on the 12 and 16 cylinder V type.

It is understood that the same method of gas distribution can be used on the twelve and sixteen cylinder V type, each group of 6 or 8 cylinders being fed by a separate carburetor. The suctions in each group of 6 or 8 cylinders would be respectively 120 and 90 degrees apart. However in the sixteen cylinder it would be also possible to duplicate the system shown in Fig. 3, so that each block of 8 cylinders is fed by two carburetors and two manifolds. These manifolds may be for each block both on one side, or on opposite sides as shown in Fig. 3 for a single bank of aligned cylinders.

In the twelve cylinder the standard angle of the cylinders would be 60 degrees and may be decreased to 30 or increased to 90 degrees as shown in Fig. 10.

In the sixteen cylinder the standard cylinder angle is 45 degrees and may be decreased to 22 and a half, or increased to 67 and a half degrees as shown diagrammatically in Fig. 4. The standard angles are indicated by full lines, the other angles by dotted lines.

Decreasing or increasing the cylinder angle will not affect the balance in the 12 and 16 cylinder type, but will affect the 8 cylinder type of Figs. 1 and 1A.

It is understood that the numbering of the cylinders and crankpins may be done in any other way without changing the system of gas distribution in any of the arrangements proposed.

The crankpins in the V eight cylinder may be considered to consist of four crankpins or of eight crankpins, the adjacent crankpins being aligned so that they may be considered to form in fact a single crankpin. The numbering in four is indicated in Fig. 1, within parentheses and in Fig. 1A without parentheses. The numbering in eight is indicated without parentheses in Fig. 1A, crankpin 1 having the connecting rod of cylinder 2, crankpin 2 having the connecting rod of cylinders 3 and 4, crankpin 3 having the connecting rod of cylinders 5 and 6, crankpin 4 having the connecting rods of cylinders 7 and 8. As is well known in the prior art, the connecting rods of opposed cylinders 1 and 2, 3 and 4, 5 and 6, 7 and 8 may be side by side on the same crankpins (that is aligned pair of crankpins) or they may be hinged upon each other on the same crankpin (in which case they still may be considered as a double crankpin). In the former case of side-by-side connecting rods the opposed cylinders 1 and 2 etc., may be slightly staggered as already shown in my Patent 1,722,950 of July 30, 1929, and in my Patent 1,911,874 of May 30, 1933. The present system of gas distribution may be equally applied in said V engines of said patents having by preference the two cylinder

banks at a very narrow angle (about half of the standard angle explained here, or even less than half), so that the group of four cylinders in engines of either of said patents, having suction intervals of 180 degrees, have one manifold and the other group being in the same condition has the other manifold. In my supplemental Patent No. 1,885,576 of Nov. 1, 1932, to these two other patents, it is shown that the angle between these two cylinder groups can be decreased to zero, in which case we arrive at the straight 8 cylinder type as shown in Fig. 3, which is the limiting case of the V type having cylinders at a very narrow angle. In all these types the gas distribution in both manifolds may be made equal, the present combination of Figs. 1 and 2 being the only exception, due to the peculiar arrangement of the crankpins.

It is further of prime importance not to choose in either of the arrangements of Figs. 1 and 1A a firing in which there are four consecutive firings in one bank of cylinders and four in the other bank. Each of the crankpin arrangements of Figs. 1 and 1A having 16 different suction sequences or firing orders, an analysis of them will show that half of them cannot be used for said reason.

It is understood that all the manifolds shown may be inverted in order to apply downdraft carburetion if preferred. It is equally understood that the two manifolds shown in the arrangement of Fig. 2 may be arranged beside or below each other, and the inlet conduits leading to the primary zones P¹ and P², may be upright and have a common air inlet as explained. The said two manifolds are shown with their primary conduits beside each other for the sake of clarity and simplicity of illustration of the principle of carburetion involved. The direction in which the gases in each manifold flow from the primary zone for consecutive suctions in that respective manifold is of great importance for the equal distribution of gases. Where such suctions alternate in direction from said primary zone the distribution to the four respective cylinders is more uniform than when said directions are the same for each pair of consecutive suctions in one manifold.

Not only the direction of extreme importance but the length of the suction period also. When these periods are considerably longer than 180°, the mixture is still moving in one direction to one cylinder when a suction period starts for another cylinder to suck a mixture from the primary zone, and partially from said branch in which the former period is not yet finished, if the consecutive suction periods are alternative in a manifold. Due to the fact that it takes time to open and close a valve gradually, and due to the fact that the piston in both cylinders, having overlapping suction periods, are near their bottom and top position, the suction is decreasing in the primary branch providing gas to the cylinder which finishes its inlet period, and the suction in the primary branch providing gas to the cylinder which starts its inlet period is increasing. The faster the engine goes the faster this decrease and increase is, and the greater the inertia forces in the gases are. If there are two consecutive suction periods in the same direction to two cylinders connected with the same primary branch, the inertia of the gases during the first period will assist the gases streaming to the other cylinder in the same direction, and when the direction of two next consecutive su-

tion periods changes, only the first suction period of the next two is disturbed by the fact that gases are still streaming in opposite direction. Therefore the distribution of gases in the first manifold will be more uniform than in the second.

Returning to Fig. 11, you see that the primary zone P in the primary conduit A is constructed in the same horizontal plane as the secondary zones S and secondary conduits B, so that the heavy ends of the gasoline may readily flow from one zone and branch to the other zone and branch. This construction improves equal distribution of wet particles to the four cylinders. In Fig. 12 another construction is shown in which the inlet conduit leads to the primary zone P and primary branches A, which are in the same vertical plane as the secondary zones S and secondary branches B. The heavy ends have therefore to rise from one level to another before reaching the cylinders, unless this manifold is inverted, in which case the wet ends of the fuel mixture drop from one level to the next. In the construction of Fig. 11, the downdraft or updraft arrangement makes no difference, except of course for the length of the riser or inlet conduit. In the updraft type the suction may not raise all the wet parts into the primary zone and branches, while in the downdraft arrangement no gasoline can accumulate before and after the fuel mixing means. It is preferred to construct the said branches with a flat bottom throughout from the inlet conduit inclusive the secondary zones and secondary branches until they reach the valve chambers of the respective cylinders.

It is understood that the cylinders may be arranged in staggered formation, according to the construction of the respective connecting rods on said crankshaft. When these connecting rods are hinged in pairs on the same crankpin, the cylinders may be exactly opposite each other. If they are arranged side by side on the same crankpin, the cylinders are arranged in staggered formation, as is well known in the prior art for V type engines.

It is further an important point of the present method of manifolding to have individual branches extending to individual cylinders, and so far as is known to applicant never before have V type engines been constructed with a longitudinal manifolding with individual branches extending therefrom transversely to the cylinders of both blocks.

I claim:

1. In an eight cylinder engine, having its 16 valves arranged in two planes, each plane containing half of the inlet valves and half of the exhaust valves, each cylinder having a single inlet and a single exhaust valve, a double and separate inlet manifold structure connecting each with half the number of inlet valves having suction intervals of 180 degrees, said manifolds being arranged lengthwise the engine, one manifold connected with the cylinders having a suction order 1, 3, 5, 7, the other manifold connected with cylinders having a suction order 2, 4, 6, 8, each manifold having a primary zone of distribution and two primary branches extending therefrom lengthwise the engine, each primary branch thereof being connected with an outer and inner cylinder of its respective group, said latter two cylinders being non-adjacent and the distances from the carbureting means in said manifolds to the cylinders of the engine being unequal.

2. In an eight cylinder engine having its inlet valves arranged in two planes, each plane containing half of the inlet valves, a double and separate inlet manifold structure so arranged that each manifold is only connected with valves having a suction interval of 720 degrees divided by half the number of cylinders, each manifold being arranged lengthwise the engine one manifold connected with the cylinders having a suction order 1, 3, 5, 7, the other manifold connected with cylinders having a suction order 2, 4, 6, 8, each manifold having a primary zone of distribution and two primary branches extending therefrom lengthwise the engine, each primary branch thereof being connected with an outer and inner cylinder of its respective group, said latter two cylinders being non-adjacent and the distances from the carbureting means in said manifolds to the cylinders of the engine being unequal.

3. In an eight cylinder engine having its inlet valves arranged in two planes, each plane containing half of the inlet valves, each cylinder having a single inlet valve and a single exhaust valve, a double and separate inlet manifold and carbureting structure arranged lengthwise the engine, each manifold being connected only with inlet valves having a suction interval of 720 degrees divided by half the number of cylinders of said engine, one of said manifolds being connected with cylinders having a suction order 1, 3, 5, 7 and the other with the cylinders 2, 4, 6, 8, each manifold having two primary branches extending in opposite direction from a primary zone therein and arranged lengthwise the engine, each of said branches being connected with an outer and inner cylinder of said group and the distances from the carbureting means in said manifolds to the cylinders being substantially uneven.

4. The combination of claim 3, said combination applied to a V-eight cylinder type of engine, having two blocks of cylinders arranged at 90° and having a crankshaft with crankpins arranged at 90°, one primary branch of said first manifold being connected with cylinders 5 and 1 and the other primary branch connected with the cylinders 7 and 3, one primary branch of said second manifold connected with the cylinders 8 and 2 and the other primary branch thereof connected with the cylinders 6 and 4, and the distances from the carbureting means to the cylinders being substantially different in each manifold.

5. The combination of claim 3, said combination applied to a straight eight cylinder type, one primary branch of said first manifold being connected with the cylinders 1 and 3, and the other primary branch thereof connected with the cylinders 5 and 7, one primary branch of said second manifold being connected with cylinders 8 and 6 and the other primary branch thereof connected with the cylinders 2 and 4.

6. The combination of claim 3, said combination applied to a V eight cylinder engine, having a crankshaft of which the crankpins are arranged at 90° so that from the front end thereof these crankpins are arranged clockwise 1, 2, 4, 3, said manifolds having each two primary branches so arranged that the distances in which the gas has to travel towards each pair of cylinders connected with the same branch are substantially different in each branch from the carbureting means thereof to said cylinders of each branch.

7. The combination of claim 3, in a V eight cylinder engine, said manifolds each having a

riser, one adjacent to the other, downdraft carburetion associated with said risers, and the distances from the carbureting means to the inlet valves of each manifold being substantially different in each of said two systems.

8. In an eight cylinder engine having its inlet valves arranged in two planes, two separate inlet manifold and carburetor systems each connected with half of said inlet valves having an interval of 180 degrees, and arranged lengthwise the engine, each manifold having primary and secondary branches extending from primary and secondary zones therein, the distances from the secondary zones to the cylinders of each system being substantially different in said two systems, and the primary branches of each manifold being connected by means of two secondary branches to two non-adjacent cylinders said manifolds being further so arranged that one manifold is connected with the cylinders having a suction order 1, 3, 5, 7, and the other manifold is connected with the cylinders having a suction order 2, 4, 6, 8, each manifold having two primary branches extending from a single primary zone therein, each primary branch having a secondary zone of distribution and two secondary branches extending therefrom, each primary branch being connected to an outer and inner cylinder of its respective group.

9. In an eight cylinder engine, in which two adjacent cylinders at one end of a block fire in immediate succession, an intake manifold and carbureting system arranged lengthwise the en-

gine, said two cylinders being connected with separate inlet manifolds, each manifold being connected with cylinders having a suction interval of 180 degrees, and the primary branches of each manifold being connected with non-adjacent cylinders, said manifolds being respectively connected with cylinders having a suction order of uneven-numbered cylinders and even-numbered cylinders, but each primary branch of said manifolds being connected only to an outer and inner cylinder of its respective group and the distances from the fuel mixing means in said manifolds to the cylinders being unequal.

10. The combination with an internal combustion engine, having eight cylinders, said cylinders divided into two groups of four cylinders not adjacent to each other, such that the suction periods of the cylinders in each group overlap each other, manifolding connecting each carburetor with all of the cylinders of its group, so that the ends of the manifolding connect with the inlet valve of individual cylinders, one manifold being connected with cylinders having a suction sequence which has an interval of 90° with the cylinders having the other suction sequence, and the primary branches of each manifold, however, being connected only with an outer and inner cylinder of its respective group.

11. The combination of claim 10, in which the ends of each primary conduit of the manifolding connects with the inlet valve of individual cylinders which are non-adjacent to each other.

JEAN A. H. BARKEIJ.

CERTIFICATE OF CORRECTION

Patent No. 2,127,079.

August 16, 1938

JEAN A. H. BARKEIJ

It is hereby certified that error appears in the printed specification of the above numbered patent requiring correction as follows: Page 1, second column, line 12, strike out the words "on the section line S11-S11"; and line 16, beginning with "Fig. 12 shows" strike out all to and including the words and period line 2B-2B., line 33, same page and column; and that the said Letters Patent should be read with this correction therein that the same may conform to the record of the case in the Patent Office.

Signed and sealed this 22nd day of November, A. D. 1938.

Henry Van Arsdale

(Seal)

Acting Commissioner of Patents.

riser, one adjacent to the other, downdraft carburetion associated with said risers, and the distances from the carbureting means to the inlet valves of each manifold being substantially different in each of said two systems.

8. In an eight cylinder engine having its inlet valves arranged in two planes, two separate inlet manifold and carburetor systems each connected with half of said inlet valves having an interval of 180 degrees, and arranged lengthwise the engine, each manifold having primary and secondary branches extending from primary and secondary zones therein, the distances from the secondary zones to the cylinders of each system being substantially different in said two systems, and the primary branches of each manifold being connected by means of two secondary branches to two non-adjacent cylinders said manifolds being further so arranged that one manifold is connected with the cylinders having a suction order 1, 3, 5, 7, and the other manifold is connected with the cylinders having a suction order 2, 4, 6, 8, each manifold having two primary branches extending from a single primary zone therein, each primary branch having a secondary zone of distribution and two secondary branches extending therefrom, each primary branch being connected to an outer and inner cylinder of its respective group.

9. In an eight cylinder engine, in which two adjacent cylinders at one end of a block fire in immediate succession, an intake manifold and carbureting system arranged lengthwise the en-

gine, said two cylinders being connected with separate inlet manifolds, each manifold being connected with cylinders having a suction interval of 180 degrees, and the primary branches of each manifold being connected with non-adjacent cylinders, said manifolds being respectively connected with cylinders having a suction order of uneven-numbered cylinders and even-numbered cylinders, but each primary branch of said manifolds being connected only to an outer and inner cylinder of its respective group and the distances from the fuel mixing means in said manifolds to the cylinders being unequal.

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